molecular orientation of the final drawn filaments.

The degree of orientation f when measured with the birefringence of the original filament in this invention is represented by the following equation. While compensation for density is necessary in the equation, it is troublesome and calculation is performed while neglecting the compensation.

$$f(\%) = (\Delta n / \Delta n^0_c) \times 100$$

Where, Δn is a birefringence obtained by actual measurement and Δn^0_c represents an intrinsic birefringence of crystalline region, which is determined based on theoretical value. While the values cannot always agree, those values often used generally are 0.24 for polyethylene terephthalate, 0.096 for nylon 6 or nylon 66 and 0.042 for isotactic polypropylene. Further, the draw ratio λ in this invention is represented by the following equation based on the diameter d_o for the original filament and the diameter d for the filament after drawing. In this case, calculation is performed assuming the density of the filament as constant. The diameter measurement is conducted by a scanning electron microscope (SEM) based on photograph taken at 350X for the original filament and at 1000X for the drawn filament, with respect to average values for 10 points.

$$\lambda = (d_o/d)^2$$

The drawn filaments in this invention are wound-up around a bobbin or cheese into products in the form of bobbin-wound on cheese-wound products. In the wound-up process, the drawn filaments are preferably wound-up while being traversed. This is because uniformly wound-up form can be ensured by traversing. In the super microfilaments, occurrence of breakage of filament or of fluff results in a most significant problem. In this invention, since the filament is highly molecular orientated and the drawing tension is small, the filament can be wound-up with a small winding tension, it is characterized in also enabling the decrease of breakage of filament or fluff.

CLAIMS

1. A method of manufacturing drawn filaments which comprises heating original filaments supplied from a filament supply means by infrared beams and then drawing the filaments heated under a tension provided by the own weight of the filaments.

2. A method of manufacturing drawn filaments which comprises heating original filaments delivered from a filament supply means by infrared beams and then drawing the filament heated under an applied tension of 1 MPa or less.

3. A method of manufacturing drawn filaments according to claim 1 or 2, wherein heating is conducted by infrared beams within a range of 8 mm.

4. A method of manufacturing drawn filaments according to claim 1 or 2, wherein the infrared beam is a laser beam.

5. A method of manufacturing drawn filaments according to claim 1 or 2, wherein filaments are delivered from a blowing duct before the filaments are heated by infrared beams.

6. A method of manufacturing drawn filaments according to claim 1 or 2, wherein a guiding tool for controlling the position of the filaments is disposed before the filaments are heated by infrared beams.

7. A method of manufacturing drawn filaments according to claim 1 or 2, wherein the original filaments are any one of polyethylene terephthalate, nylon and polypropylene filaments.

8. A method of manufacturing drawn filaments according to claim 1, 2, or 7, wherein the draw ratio of drawn filaments is 1000 times or more.

9. A method of manufacturing drawn filaments according to claim 1, 2 or 7, wherein the original filaments have a degree of orientation of 30% or more

when measured in view of a birefringence and are drawn with an swelled portion larger than the diameter of the original filaments at the drawing start point.

10. A method of manufacturing drawn filaments according to claim 1 or 2, wherein the obtained drawn filaments have a diameter of 5 μm or less.

11. A method of manufacturing drawn filaments according to claim 1 or 2, wherein the drawn filaments are heated in a heating zone disposed subsequently.

12. A method of manufacturing drawn filaments according to claim 1 or 2, wherein the drawn filaments are wound up.

13. A method of manufacturing drawn filaments according to claim 1 or 2, wherein the drawn filaments are further drawn and then wound up.

14. A method of manufacturing non-woven fabrics comprised of drawn filaments according to claim 1 or 2, wherein the drawn filaments are accumulated on a running conveyor.

15. An apparatus for manufacturing drawn filaments comprising a supply device for original filaments and an infrared beam emitter for heating original filaments within a range of 8 mm or less in which the heated filaments are drawn by tension provided by their own weight or tension of 1 MPa or less.

16. An apparatus for manufacturing drawn filaments according to claim 15, wherein the infrared beam emitter is a laser emitter.

17. An apparatus for manufacturing drawn filaments according to claim 15 or 16, wherein the laser beam is a carbon dioxide gas laser having a power density of 15 W/cm^2 or more.

18. An apparatus for manufacturing drawn filaments according to claim 15, wherein a heating device having a heating zone is provided to the drawing means and the drawn filaments are heated.

19. An apparatus for manufacturing drawn filaments according to

claim 15, wherein a filament wind-up means is further provided to the filament drawing means.

20. An apparatus for manufacturing drawn filaments according to claim 15, wherein a drawing means is further provided to the apparatus for manufacturing drawn filaments.

21. An apparatus for manufacturing non-woven fabrics comprised of drawn filaments according to claim 15, wherein a running conveyor is disposed to the manufacturing apparatus of the drawn filaments, and drawn filaments are accumulated on said conveyor.

22. An apparatus for manufacturing drawn filaments according to claim 15, wherein a blowing duct is disposed before heating of the original filaments by the infrared beams, and the original filaments are delivered by the blowing duct.

23. An apparatus for manufacturing drawn filaments according to claim 15, wherein a guiding tool for controlling the position of the filaments is disposed before heating of the original filaments by the infrared beams.

24. A super microfilament in which the drawn filaments according to claim 1 or 2 have a draw ratio of 1000 times or more.

25. A super microfilament in which the drawn filaments according to claim 1 or 2 are drawn with a swelled portion larger than the starting filament diameter at the drawing start portion.

26. A highly oriented super micro filament in which the drawn filaments according to claim 1 or 2 are nylon 6 or nylon 66 and have the birefringence of 35×10^{-3} or more and the fiber diameter of 5 μm or less.

27. A highly oriented super micro filament in which the drawn filaments according to claim 1 or 2 are polyethylene terephthalate and have the birefringence of 30×10^{-3} or more and a diameter of 5 μm or less.

28. A highly oriented super micro filament in which the drawn filaments according to claim 1 or 2 are isotactic polypropylene and have the birefringence of 20 x 10^{-3} or more and a diameter of 5 μm or less.